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EC24-721 Dairy Barns for Nebraska

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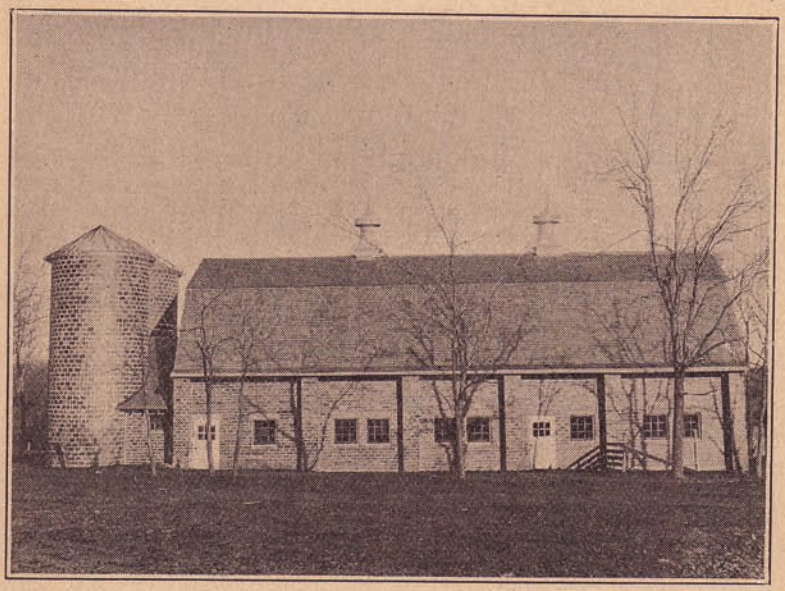

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DAIRY BARNS FOR NEBRASKA

OSCAR W. SJOGREN AND IVAN D. WOOD

The increasing interest shown among the farmers thruout this state in the betterment of dairy stock, and the tendency to give more attention to dairying on the farms, is bringing to the Agricultural College a great many requests for plans and suggestions for dairy barn construction. It is impossible to give every one of these inquiries individual attention to the extent of drawing a detailed plan to suit the conditions in each case. It is hoped therefore, that the material contained in this bulletin will offer helpful suggestions and answer many questions in the minds of prospective dairy men and dairy barn builders relative to the arrangement and construction of barns.

COSTLY BARNS UNNECESSARY

There has been a general, altho erroneous impression prevalent in the past, that one could not engage in the dairy business unless he had a costly and elaborate plant, consisting of a large barn and an up-to-date milk house or creamery, equipped with the latest and most up-to-date contrivances. Such equipment is desirable and necessary on the part of the man who makes a specialty of dairying, but it cannot be afforded by the man who keeps only two or three cows and carries on his dairying as a side line to his other farm operations. The making of good dairy products depends primarily upon cleanliness and proper procedure and it is just as possible to secure these in a small plant with simple equipment as in a large plant elaborately equipped. The plans shown in this bulletin have been prepared for the man who keeps a small herd and are so arranged that a man can start in a small way with two or three cows and as he gains experience and knowledge he may expand the business and increase the number of cows. In enlarging his plant it should not be necessary for him to discard the part already built, but it should be possible for him to use the original building as a part of the larger unit.

TYPES OF BARNS

There are a number of barn types from which the dairyman may make selection, for example: One story barns, basement barns, two story barns, round barns, rectangular

barns, etc. There is no best type for all conditions. Some of the more important factors which enter into the selection of a type of barn are: climate, topography, location relative to other buildings, size, cost, available building materials, and local regulations covering the production and disposal of dairy products. The farmer must consider these factors and make his choice of type based thereon and upon his individual preference.

BUILDING SITE

A building site should be selected which is well drained so that the barnyard and the yards adjacent may be kept reasonably free from mud and filth. The site should permit the placing of the barn so as to admit an abundance of sunlight and allow free movement of air. If a windbreak can be had to the north, that is desirable. All things considered, it is most desirable to have the long axis of the barn run north and south as this permits the most sunlight to enter the barn and also simplifies the ventilation problem in summer, as the prevailing winds are then from a southerly direction. The site should be accessible for unloading feeds such as hay, straw and grain, filling silos, and hauling away manure. It should permit a convenient arrangement of yards and lanes and be conveniently situated with regard to the pasture.

PLANNING THE BARN

There are many factors that must be considered in the planning of a barn, chief among which are size, cost, arrangement, and sanitation. A great deal of thot and study should be given to the planning before beginning the building operations. A careful study of a proposed plan will often show minor changes in the arrangement which will effect a big saving in labor required in caring for the stock. A plan drawn to scale, or to proper proportions, will give the owner a picture of how his barn will be arranged and will enable him to readily detect mistakes in measurements or in locations of various parts. Workmen make fewer mistakes and will do better work if they are required to follow a good plan rather than to work out the construction and arrangement as they go.

Size

The size of the barn depends primarily upon the number of stock kept and the storage space required for feed. The barn should be large enough to care for the present needs of

the farm and to allow for a reasonable growth in crop and stock production. The arrangement should permit enlarging the barn should such be desired.

Cost

The cost of the barn should be kept down to a minimum in order that the housing cost shall not be excessive. If a satisfactory barn can be built for $100 per cow it would be foolish to spend $1500 to $2000 for the same space, as the interest on the additional cost may amount to a sum nearly as great, or perhaps greater, than the value of the cow's yearly production. The overhead cost must be kept down to an amount which will permit a reasonable profit being received from the business.

Sanitation

The production of good milk and other dairy products requires that the barn and surroundings be kept in a sanitary condition. This requires dry yards and barns, supplied with an abundance of light. The interior of the barn should be such as to make it easily cleaned and kept clean. There should be no cracks, crevices or pockets where dust may lodge. All corners should be rounded.

Arrangement

The arrangement, not only of the barn but of the yards, lots and surroundings, should be such as to save labor. Dairy work must be done twice each day in the year and a slight fault in arrangement may require the doing of a large amount of extra work in a year's time. The feed should be stored close at hand and conveniently located in order to reduce the labor of feeding. While small barns may not require the use of feed trucks and litter carriers, the arrangement should nevertheless, be such as to permit their use in case the barn is enlarged to a point where they can properly be used. A silage truck large enough to carry the necessary amount of silage for one feeding will be found a great convenience. An overhead loft for the storing of hay is recommended because it permits the feeding of hay with a minimum of labor.

Removal of Manure

Means should be provided for the removing of manure quickly and easily. Gutters for collecting the manure and

litter carriers or trucks for hauling it will permit this, or, the barn may be so arranged that a team with wagon or spreader can be driven thru the alleyway and the manure removed directly from the gutter and hauled to the field.

Handling of Milk

The milk room or milk house should be located in or very close to the barn so as to require no unnecessary steps or loss of time in taking milk from the barn to it. Certain cities endeavor to control the conditions under which the market milk is produced and require that the milk house be detached and at a certain minimum distance from the barn. If one is to sell milk in a city, he should inform himself on this point.

Comfort of Cows

To do her best the cow must be comfortable. This fact should be borne in mind when planning and building the barn. The stalls should be made of ample size and the stanchions or ties should be designed and arranged to permit the cow to lie down comfortably. Steep approaches at the doors or anywhere else in or about the barn should be avoided. The temperature of the barn in winter should not fluctuate widely and proper attention should be given to ventilation details.

Combined Barns

Where only a few cows are kept as on the general farm, it would not be economy to have one barn for the cows and another one for the horses. A barn which will house both classes of stock is therefore desired. It is desirable that the two parts of these barns be divided by a solid partition so that the cows and horses may be kept separate and the odors from the horse part will not reach the dairy portion of the barn.

DETAILS OF CONSTRUCTION

The plans contained in this bulletin indicate the proper widths for barns of various arrangements of the floor plan. The proper dimensions for stall lengths and widths, as well as for mangers and gutters are also indicated. No appreciable changes should be made in the dimensions shown on the plans.

Foundations

A concrete foundation is usually the cheapest and best and can be most easily laid by unskilled labor. It should extend

down into the ground far enough to provide a good bearing and, in case of masonry barns, it should extend below the frost line. It should extend far enough above the ground and floor level to prevent moisture coming in contact with the sills and other framework. The plan of extending the foundation up to the bottom of the windows is a good one.

Walls

The barn walls may be built from a variety of materials such as: lumber, brick, hollow tile, or concrete. Regardless of the material used, the walls should be built so that they will be dry and keep the barn warm. They should be smooth in order to be easily cleaned.

Roof

On the small barns the shed or gable roof is generally used, while for medium sized and larger barns the Gambrel or Gothic roofs are used as they provide more mow space, are self supporting, and require no interior posts or beams for support when properly designed and built.

Floor

Concrete makes the most satisfactory floor for the barn as it is easily laid, is reasonable in cost, and is easily cleaned. Unless kept well bedded it will feel cold due to the fact that it is a good conductor of heat and cold. For this reason the stalls are often floored with creosoted wood blocks or cork bricks. These must be laid on a concrete base according to specifications for the particular material used. Smooth and slippery floors are not desirable, especially in the stalls and passageways. Concrete floors are generally finished with a wooden float or a brush to avoid their being too smooth.

Gutters

The gutters are made with vertical sides as indicated in Fig. 8. The width should be not less than 16 inches in order to permit easy cleaning with an ordinary shovel. The gutter should slope toward one end of the barn so that it may be washed out, and a drain should be placed at the low end to carry off the liquid. When the barn is long the drain may more properly be placed at the middle of the barn to prevent the gutter becoming too deep at the drain. This drain must be of ample size to reduce the possibilites of clogging and its

opening should be covered with a grating and bell trap to prevent chaff and other coarse material from entering.

Alleys

Litter alleys should be of ample width and have a slope of about 1 inch in 5 feet from wall to gutter, or, in case of a central litter alley, its floor may be crowned so as to give a slope as above from the center to the gutters on each side.

Stanchions and Ties

The various types of commercial stanchions are pretty well standardized and any of them should be satisfactory. In temporary buildings or in case one is limited in amount of capital, a fairly satisfactory stanchion can be made out of lumber. Such stanchions however, will not permit the cow to lie down with any degree of comfort unless specially arranged, in which case they would cost as much or more than the commercial type.

Box Stalls

There should be some available space in a small barn which may be converted into a box stall at calving time. In the larger barns it is well to provide regular box stalls. These should be not less than 10′ x 10′ and better, 10′ x 12′ in size.

Calf Pens

Calf pens may be built at one end of the barn or in an addition at one side of the barn or in a separate building. About 30 square feet of floor space should be allowed for each animal. Stanchions should be provided for feeding and require about 28″ of manger space. These stanchions may be purchased from dealers in cow barn equipment or made of wood. The calf pen should have an abundance of sunlight and be well ventilated.

Facing In or Out

The stalls may be placed so that the cows face each other toward the center of the barn or face away from each other towards the wall. Neither method can be said to be superior to the other and the plan adopted will depend upon local conditions and the individual preference of the owner.

Mangers

Concrete mangers are to be preferred to those of other materials as they are easily constructed, are more sanitary, and more easily cleaned. The manger may be easily washed out if given a slight fall in one direction and a drain installed at the low end.

Windows

Ordinarily, four square feet of window area is allowed for each stall, or one square foot of window area to twenty square feet of floor area. The windows should be placed so that the sill is at least four feet above the floor line. It is desirable to have them arranged so that they can be opened to assist in ventilation, especially in summer.

Width of Doors and Passages

The doors and alleys thru which the cows must pass should be of such width that the cows need not squeeze thru and yet not so wide as to encourage two cows to try and pass thru at the same time, causing them to crowd and possibly becoming injured. From 3′–6″ to 4′ will be found desirable.

Ventilation

Some means must be provided to admit fresh air into the barn and to carry out the foul air during the portion of the year when the barn must be kept closed more or less on account of the weather. This is generally accomplished by a system of inlets, outlets, and flues. The ventilation system most commonly used is known as the King system. This is so designed that it removes the foul air from the barn by means of flues rising to and passing thru the peak of the roof and at the same time provides for the entrance of fresh air thru flues which pass from the outside walls to the inside of the barn. This system operates on the principle that warm air being lighter than cold air tends to rise, while the cold air tends to settle. To insure the proper operation of any ventilating system it must be properly constructed and the barn so built that it can function. This means that the doors, windows and walls must be built so that air will not pass thru them when closed but must pass thru the flues.

Each outlet flue should have a cross-sectional area of about 24 to 30 square inches per cow. One or two large outlet flues are more efficient than a number of smaller ones of equal

area. Good flues are air-tight and as straight as possible with smooth interiors. They are constructed so that the air is not materially cooled in passing thru them. They generally extend down to the ceiling only, but in extreme cold climate they may extend down to within 12 to 18 inches from the floor.

Properly designed fresh-air intakes are small in area and are placed from 7 feet to 12 feet apart in the side walls. The outside openings are at least 5 feet below the openings into the barn which are placed in, or just below the ceiling. This is to prevent the escape of warm air thru the intake flues.

The total area of all intake flues should be approximately the same as that of the outlet flues. The drawings indicate the method of installation. For ventilating small barns the tilting window is probably the most practicable. This avoids the necessity of constructing flues and openings.

WATER SUPPLY

An abundant supply of fresh, pure water should be provided at all times. The cows may be watered from a tank placed in the yards or barn, or, where a water supply system is available, the water may be run into the concrete manger or an individual drinking cup system may be installed. The latter is the most expensive as far as first cost is considered, but it is more desirable from the standpoint of preventing the carrying of disease from one animal to another, and does not require the cows to go out into the cold for water. Where the cows drink from a tank care should be taken that they are not allowed to drink ice cold water, hence a tank heater is a desirable part of the equipment. Care must be taken in winter that the pipes leading into the barn do not freeze.

SUGGESTED PLANS

In the following plans an effort has been made to make them practicable as well as economical in cost. The smaller plans contain no storage space for hay or grain, making it necessary to store all feeds outside or in other buildings and carry them in at feeding time. It is not intended that this should be a permanent arrangement, but is merely temporary and will serve until the income from the cows justifies an enlargement of the plan. The arrangement of the floor plans is such that they can readily be incorporated later into larger units. A careful study should, therefore, be made of possible larger plans before building so that the small barn will later be adapted as a part of the larger plan.

USE OF OPEN SHED

Growing stock need not be confined in a tightly closed barn, in fact the concensus of opinion seems to be that such stock will thrive much better in an open shed which leaves them free to go in and out as they please, and yet will offer protection, keeping the stock dry during inclement weather.

Fig. No. 29 shows an open shed which can be built at a reasonable cost and which is well adapted for protecting young stock and dry cows. A bull stall is planned for one end of this shed and is so arranged that it is not necessary to go into the pen to feed or water him. A breeding pen is arranged outside so that it is unnecessary to handle him at any time. This is very desirable as frequently bulls are vicious and dangerous to handle. Very often a supposedly gentle bull turns on his keeper and it is best to arrange the pens so that no leading or handling will be necessary.

MILK HOUSE

Figures 24, 25 and 26 show a small milk house which can be built at small cost. The dimensions may be enlarged slightly if there is need for a larger house. The work space should be large enough to give room for the cream separator, the churn and butterworker, a water heater of some kind, and a sink and drying rack. The water heater may be a small laundry stove in which cobs or wood may be used as fuel. A wash boiler placed on the top of the stove may be used to heat the water or a special boiler may be made up for this purpose. A metal faucet attached to the boiler near the bottom will be found a great convenience in drawing off water and will do away with the necessity of dipping it out. In the large milk houses a steam boiler may be used for heating water and furnishing steam for sterilizing the equipment. The sink should have two compartments, or rather be made up of two vats large enough to take a large milk can. Hot washing water should be in one vat and hot rinsing water in the other. They should be equipped with drain plugs in the bottom and the waste water may be run into the floor drain or into a special drain pipe leading out of the building.

The cooling tank is made of concrete and is placed at one end of the house. The water from the well runs thru this tank on its way to the stock watering tank. The milk and cream cans are placed in this tank and are kept cool by the fresh well water circulating around them. Care should be taken to have the fresh water led to the bottom of the tank as shown.

USEFUL DATA IN PLANNING BARNS

Stall Dimensions

Width: minimum 3′–0″ average 3′–6″ Large 4′–0″

Length: for small cows Jerseys 4′–6″ to 4′–9″
for average sized cows Guernseys-Ayrshires 4′–8″ to 5′–0″
for large sized cows Holsteins-Shorthorns 5′–0″ to 5′–6″

Height of ceiling—8′
Width of manger 24″ to 40″
Width of feed alley, cows facing out 3′–0″ to 5′–0″
Width of feed alley, cows facing in 6′–0″ to 8′–0″
Width of litter alley, cows facing out 6′–0″ to 10′–0″
Width of litter alley, cows facing in 3′–6″ to 5′–0″

Doors

Width: 3′–6″ to 4′–0″
Height: 6′–6″ to 7′–0″
These are minimum where cows must pass thru.

Light Area Required

4 sq. ft. of glass area per stall, or,
4 sq. ft. of glass area per 1000 lbs. live weight, or,
1 sq. ft. of glass area for 20 sq. ft. of floor area.

Air Space Required

500 cu. ft. per 1000 lbs. live weight.

Feed Storage Space Required

Hay:
2 tons per cow per season.
1 ton loose hay occupies about 512 cu. ft.
1 ton baled hay occupies about 80 cu. ft.

Grain and millfeed:
1500 to 1800 pounds.
1 bushel occupies 1¼ cu. ft.
1 bushel ear corn occupies 2½ cu. ft.

Silage:
4 tons.

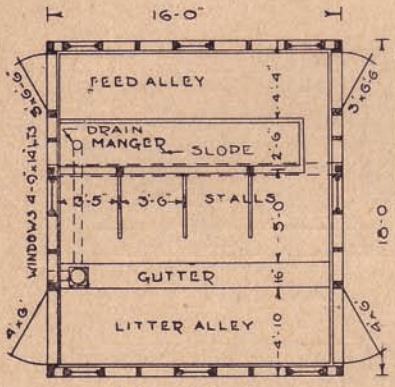
Straw:
2 tons per animal per season.
1 ton occupies 600 to 800 cu. ft.

Water

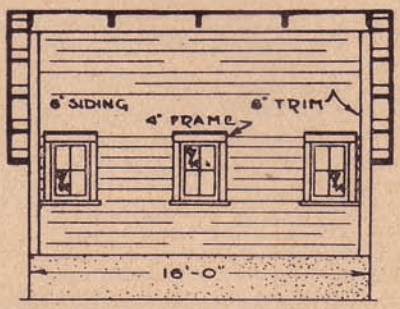
Provide a minimum of 15 gallons per day per animal; may require as much as 40 gallons at times and under certain conditions. Where running water is available, more will be required than where not.

Open Sheds

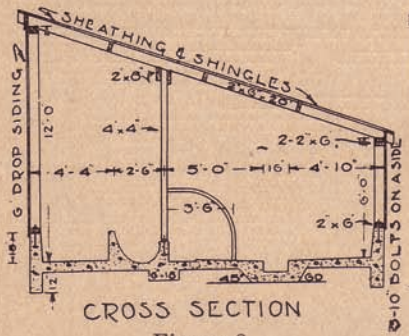
Provide 40 to 60 sq. ft. of floor space per animal.



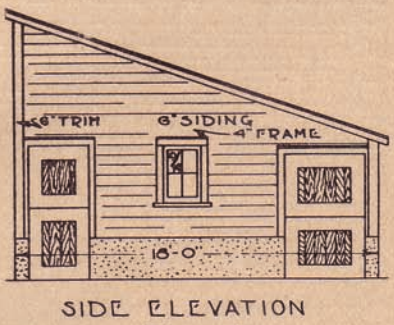
FLOOR PLAN
Figure 1



FRONT ELEVATION
Figure 2



CROSS SECTION
Figure 3



SIDE ELEVATION
Figure 4

Plan No. 10.732-40

This plan is designed for the man who wishes to keep only 3 or 4 cows and house them at a minimum cost. If it becomes necessary to enlarge this barn later, it can be used as a part of a larger unit as shown in following plans.

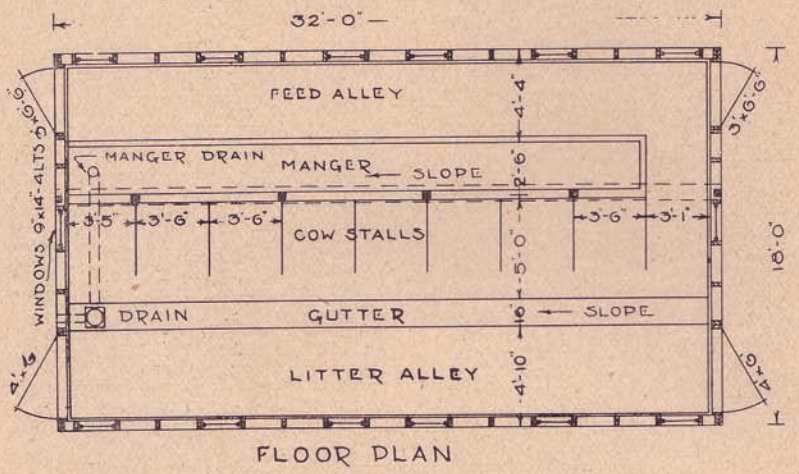


Figure 5

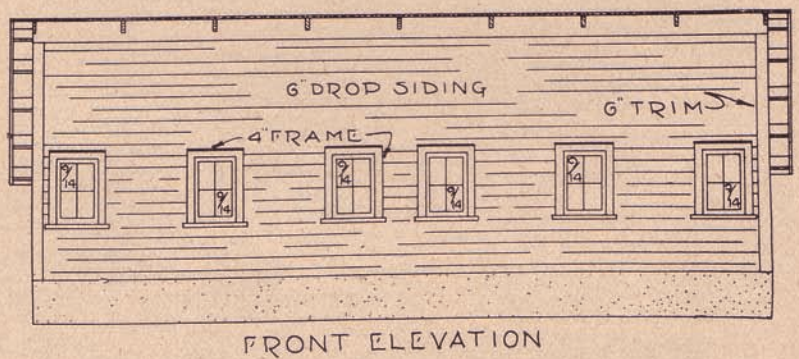


Figure 6

Plan No. 10.732-41

If space is required for from 6 to 8 cows at a minimum cost, this plan will fill the need.

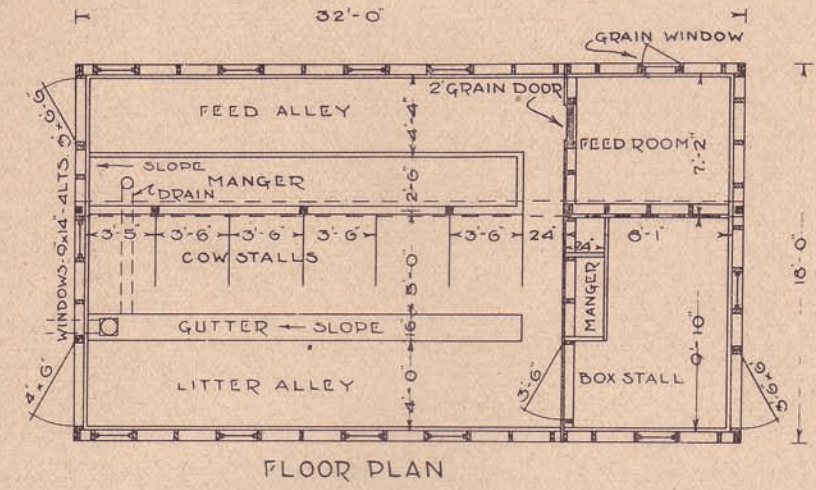


Figure 7

Plan No. 10.732-42

This plan provides space for 6 cows and contains a feed room and box stall. The box stall can be used as a calf pen, bull pen, or maternity stall.

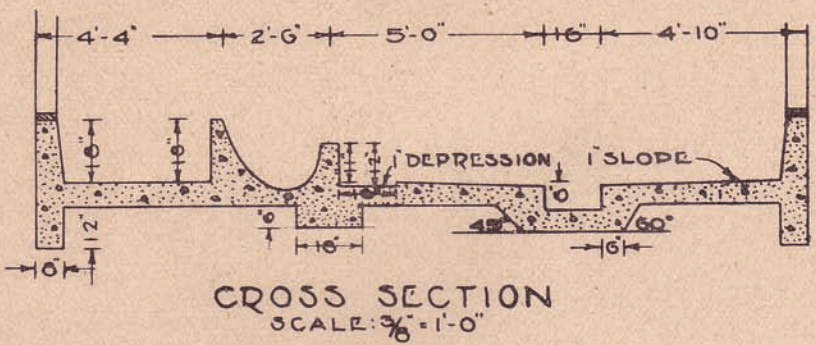
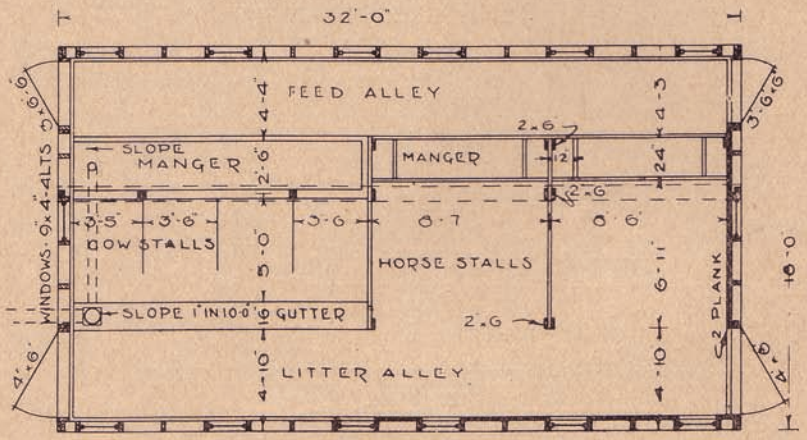


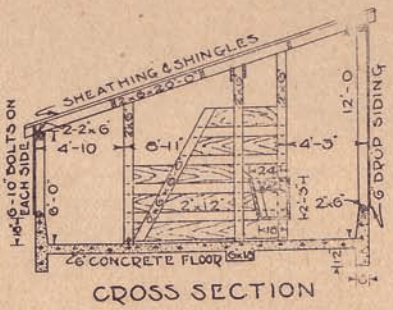
Figure 8

Detailed cross section, showing dimensions of alleys, manger, gutter and foundation.



FLOOR PLAN

Figure 9



CROSS SECTION

Figure 10

Plan No. 10.731-73

Frequently it becomes necessary to build a barn for both cows and horses. This plan indicates a convenient arrangement of such a barn.

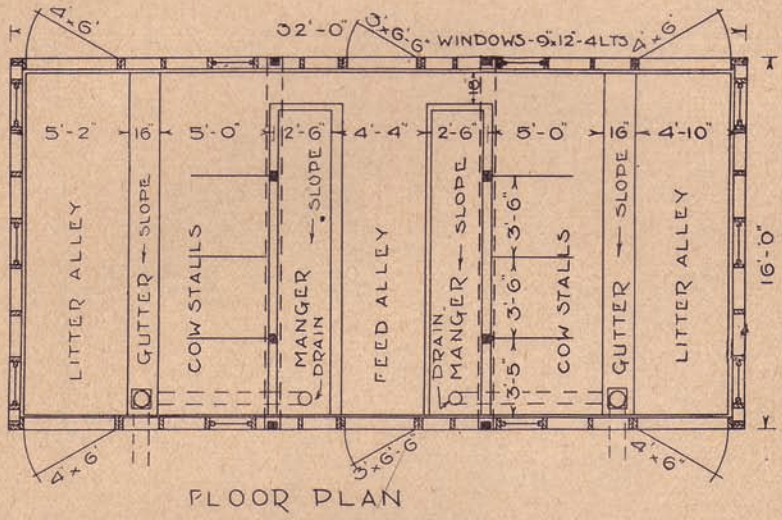


Figure 11

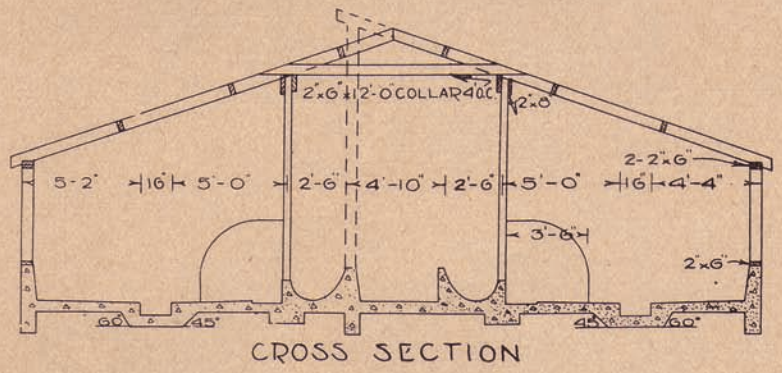
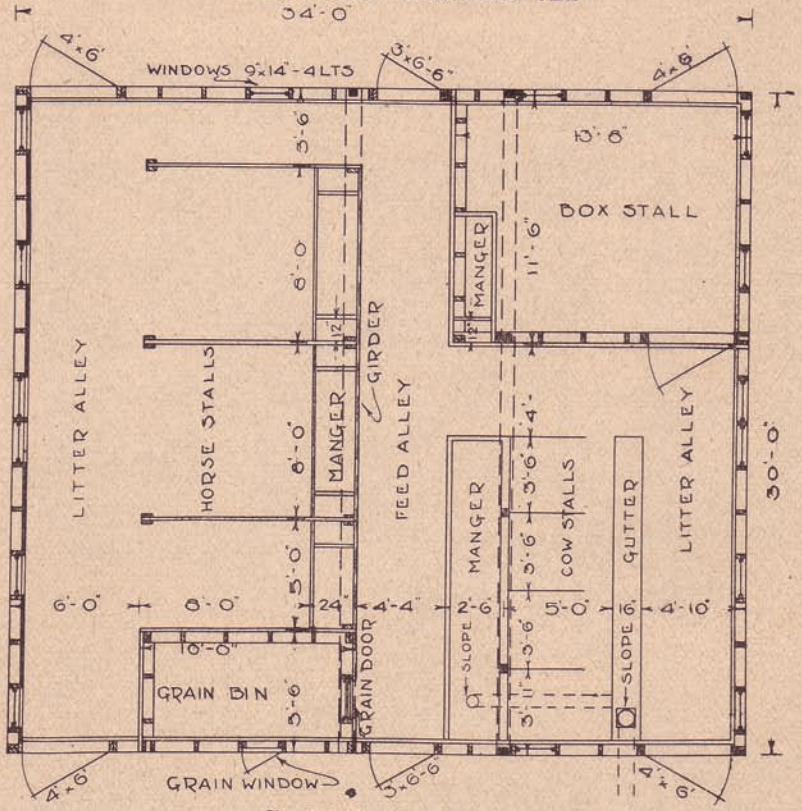


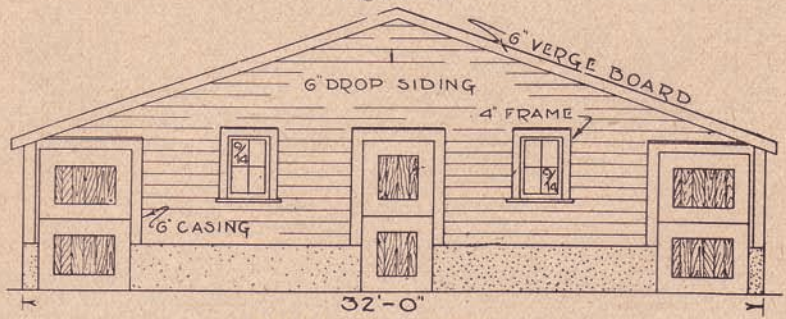
Figure 12

Plan No. 10.732-43

In this plan an addition is made to Plan No. 10.732-40 at the side as shown and just doubles the size of the barn. The outside foundation wall of Plan No. 10.732-40 is used as one side of the manger. The material contained in the high side of the small barn is used in the side and ends of the enlarged barn.



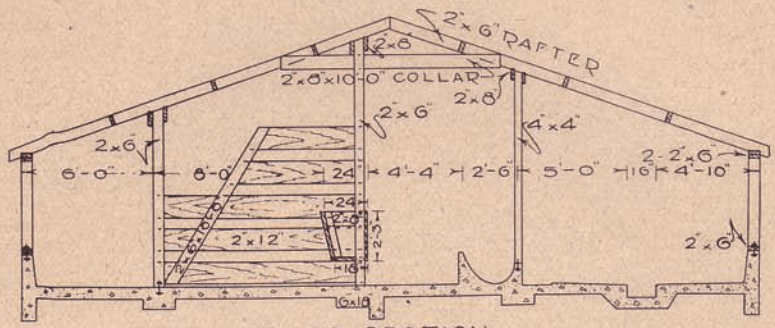
FLOOR PLAN
Figure 13



SIDE ELEVATION
Figure 14

Plan No. 10.731-74

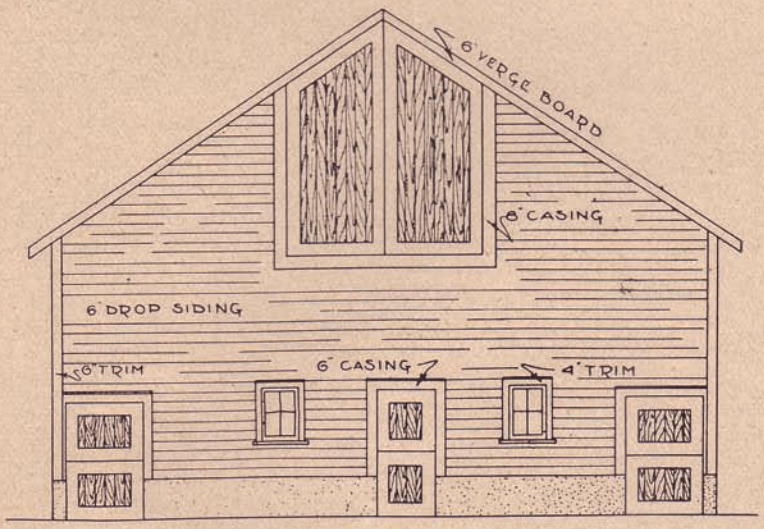
This plan allows for considerable expansion and is arranged as a combined barn. It contains a box stall, feed room, and provides space for 5 horses and 4 cows. The walls may be made high enough to provide mow space for the storing of hay.



CROSS SECTION

Figure 15

Plan No. 10.731-74

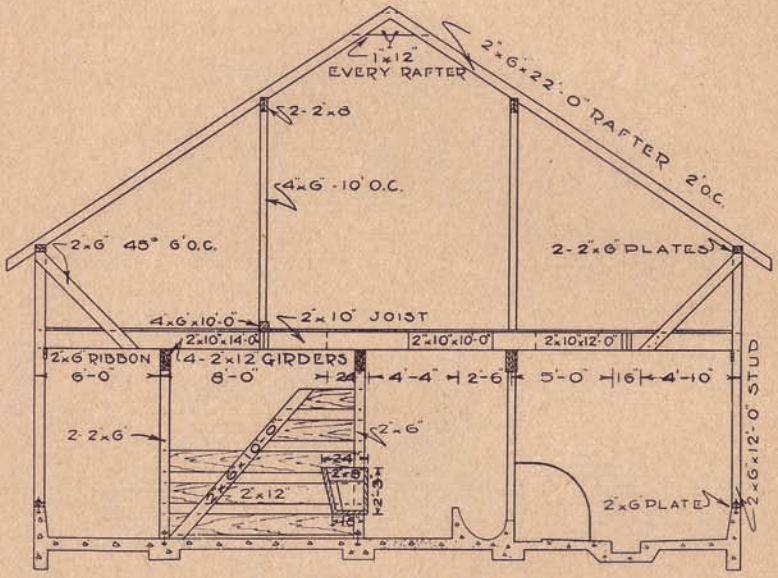


END ELEVATION

Figure 16

Plan No. 10.731-75

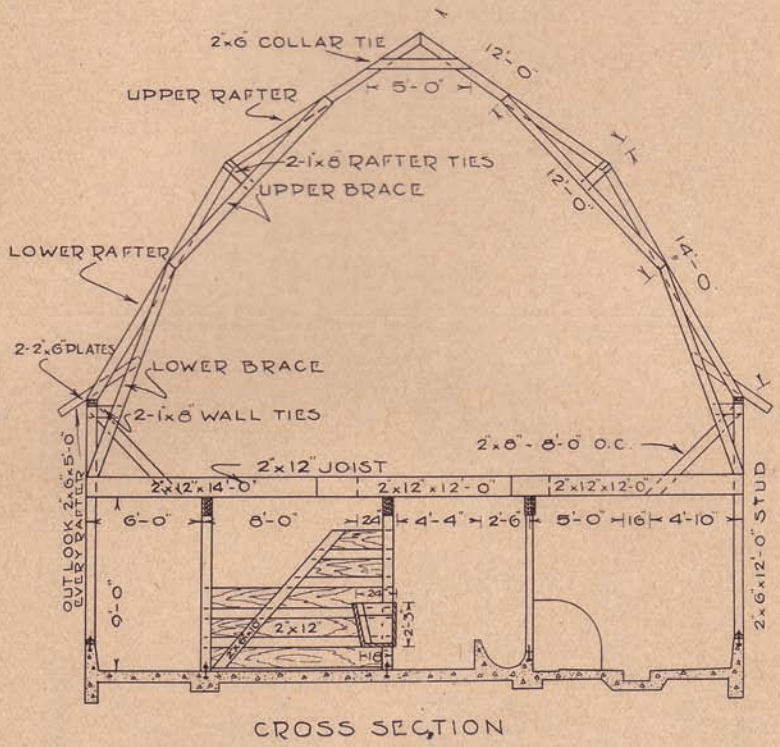
The floor plan for this barn is the same as shown in Figure 13. Space for hay loft is obtained by raising the roof as shown.



CROSS SECTION
Figure 17

Plan No. 10.731-75

Cross section of Figure 16. Floor plan same as Figure 13.



CROSS SECTION

Figure 18

Plan No. 10.731-76

The floor plan used with this cross section is the same as shown in Figure 13. The self supporting roof allows more room in hay loft.

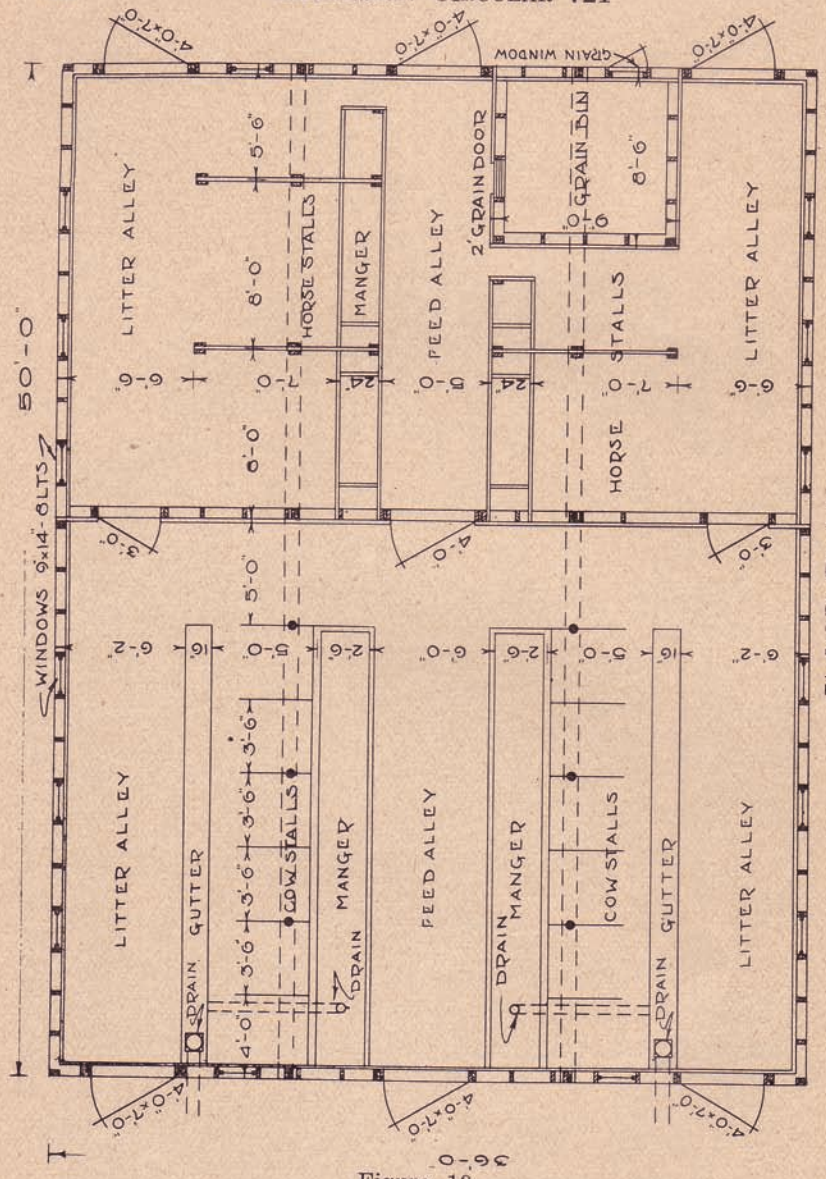


Figure 19

Plan No. 10.731-79

A plan which provides space for 8 horses and 12 cows, all under the same roof but with a solid partition between the two parts of the barn.

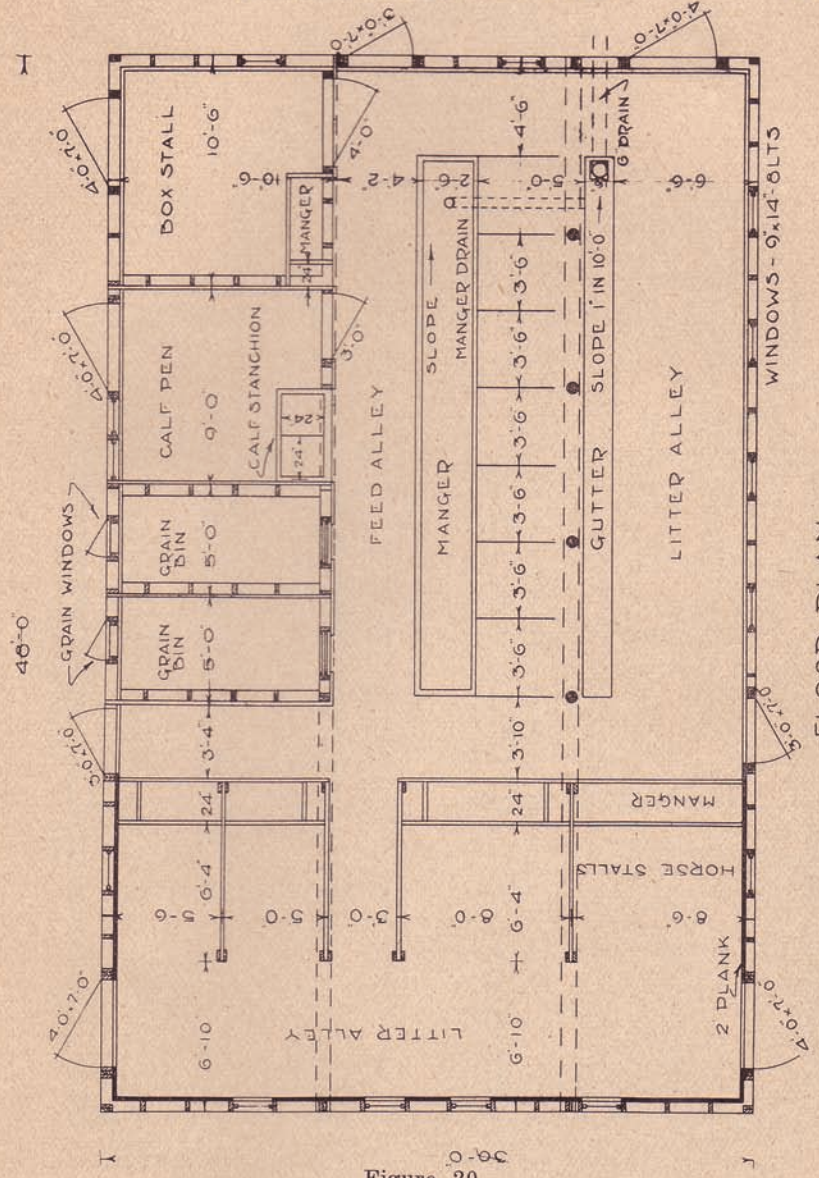


Figure 20
Plan No. 10.731-78

A general purpose barn which will accommodate 6 horses and 7 cows. A box stall, a calf pen and 2 grain bins are also provided. The bins are centrally located, thus insuring feeding in the quickest possible time and with a minimum amount of labor.

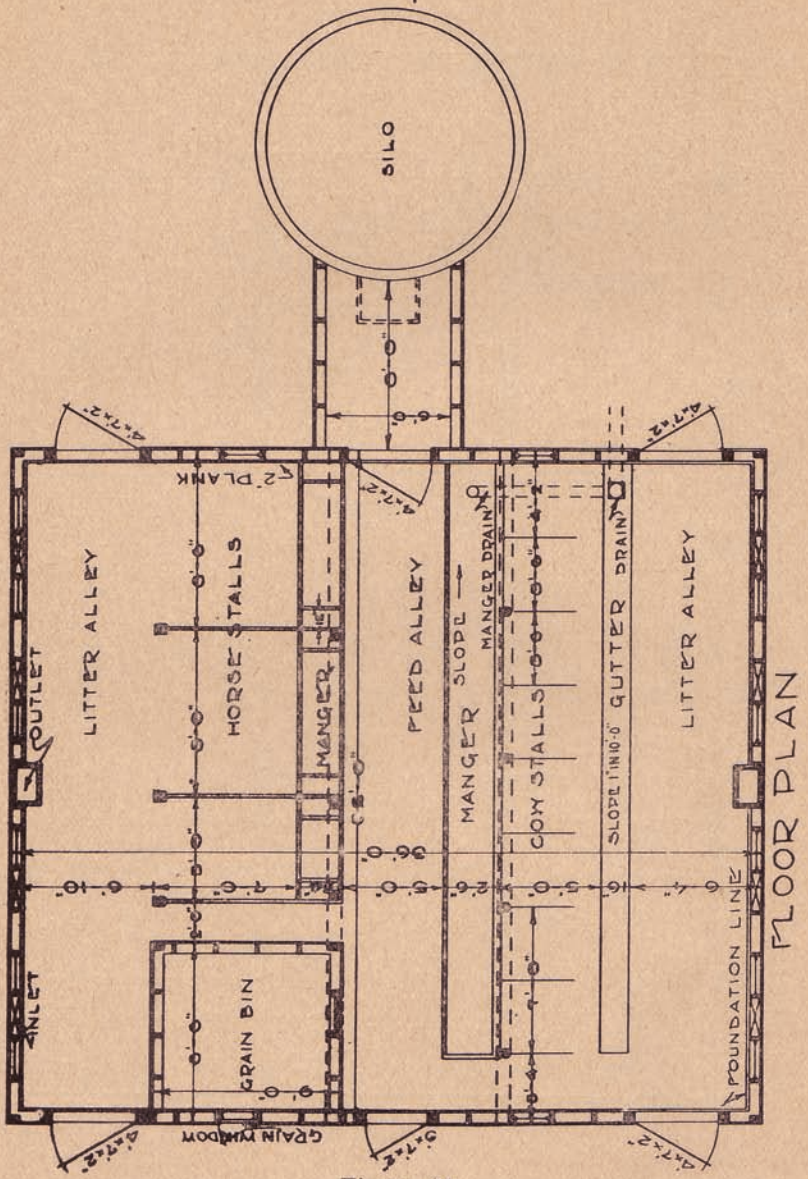


Figure 21
Plan No. 10.731-77

This combination barn will take care of 5 horses and 8 cows and has a grain bin in the barn. The silo is placed at one end.

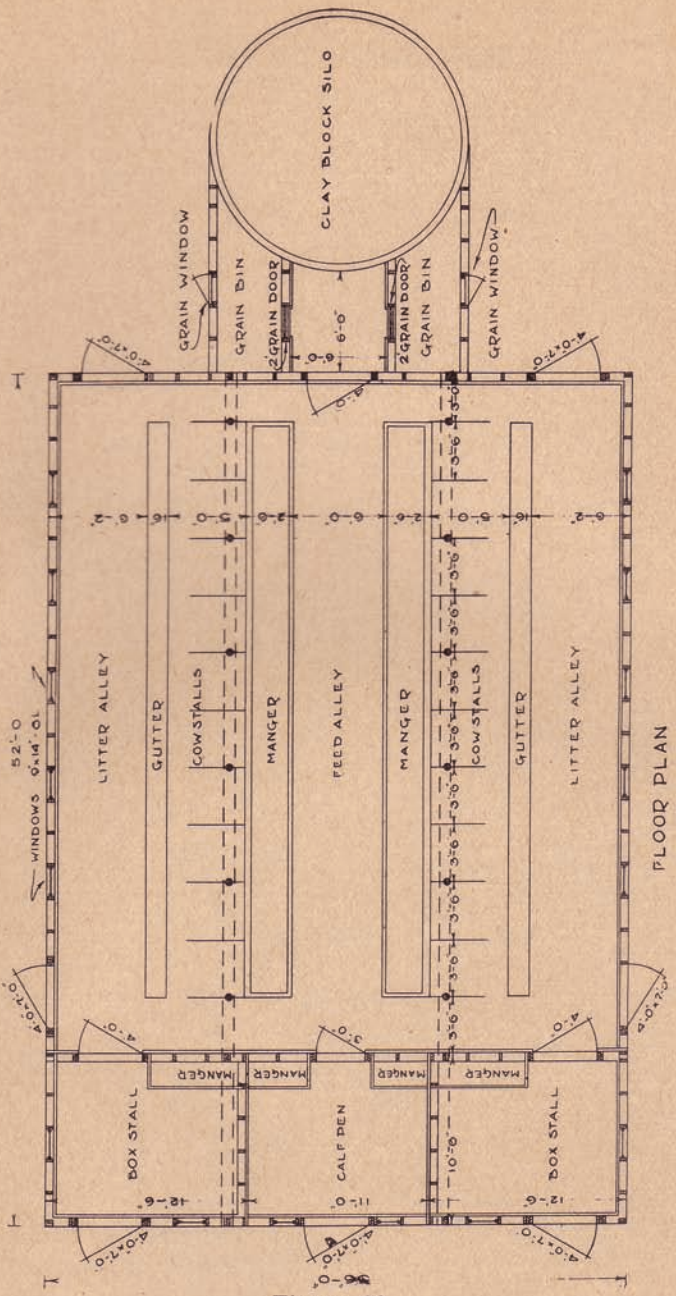


Figure 22
Plan No. 10.732-44

This size dairy barn provides enough space for 20 cows, 1 calf pen and 2 box stalls. There are 2 grain bins attached to the silo.

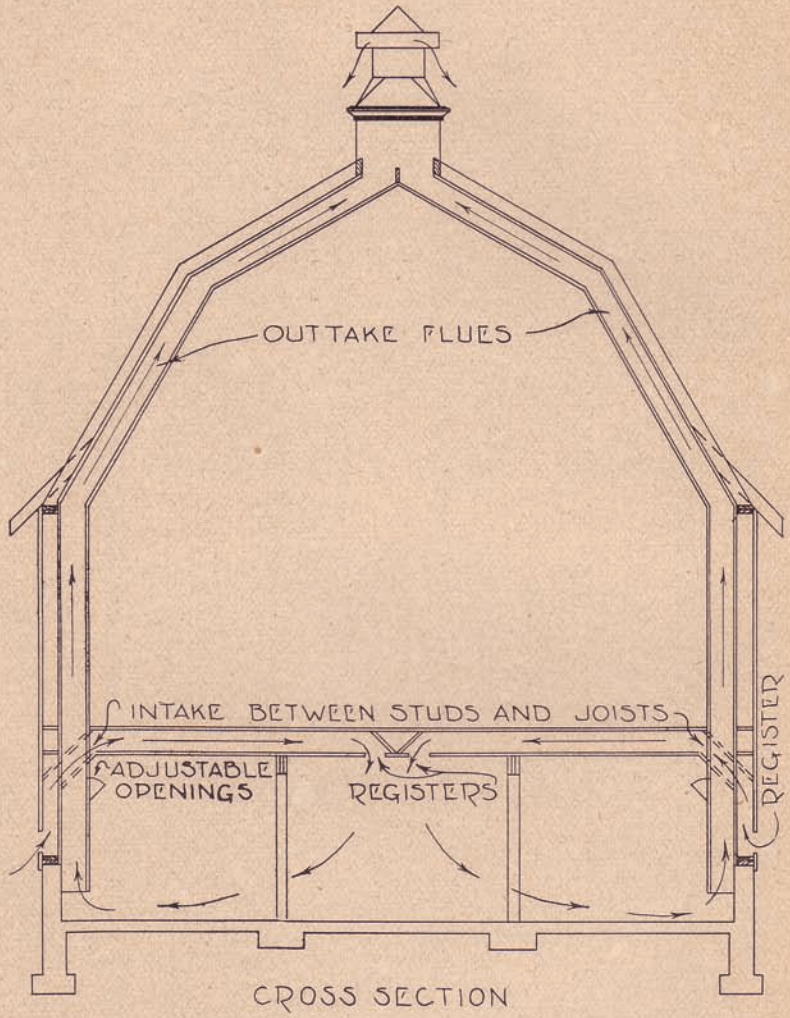
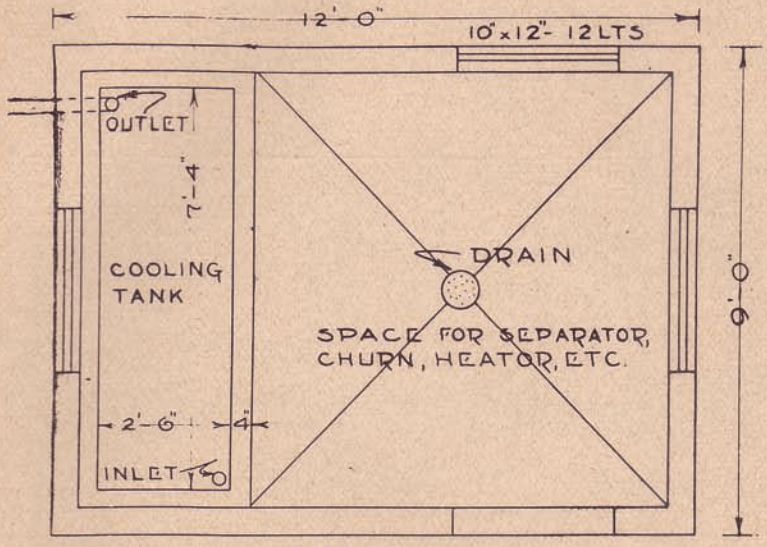


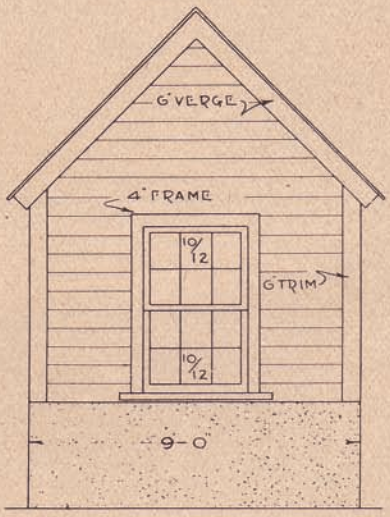
Figure 23

This shows the principle of barn ventilation and the paths followed by the fresh air coming in and the foul air going out.



FLOOR PLAN

Figure 24



END ELEVATION

Figure 25

Plan No. 10.7921-1

A small milk house which contains a cooling tank and a space large enough for a separator, a churn, a heater, etc.

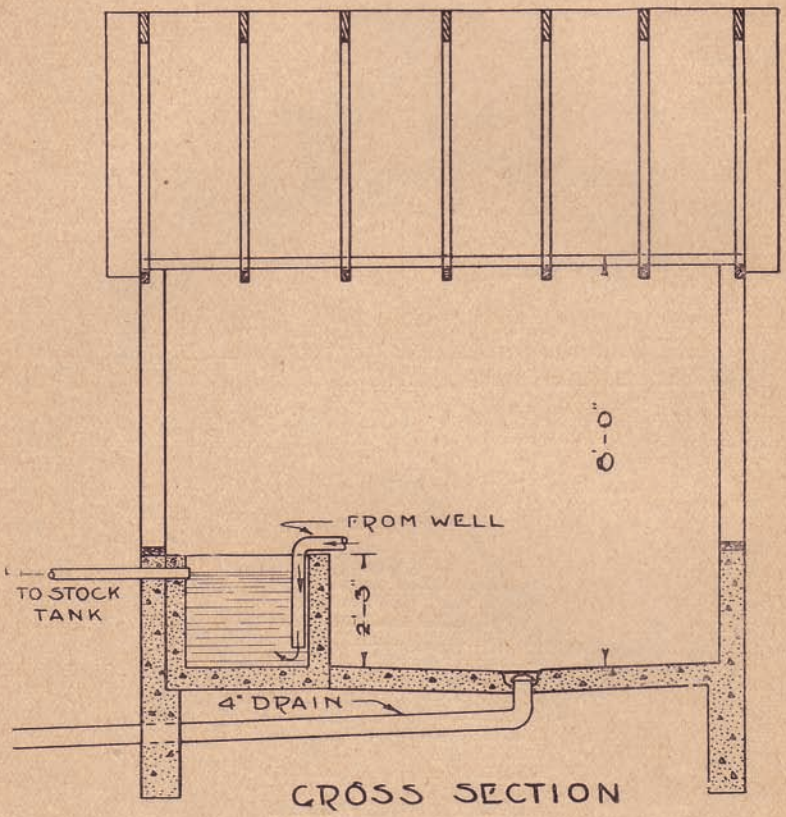
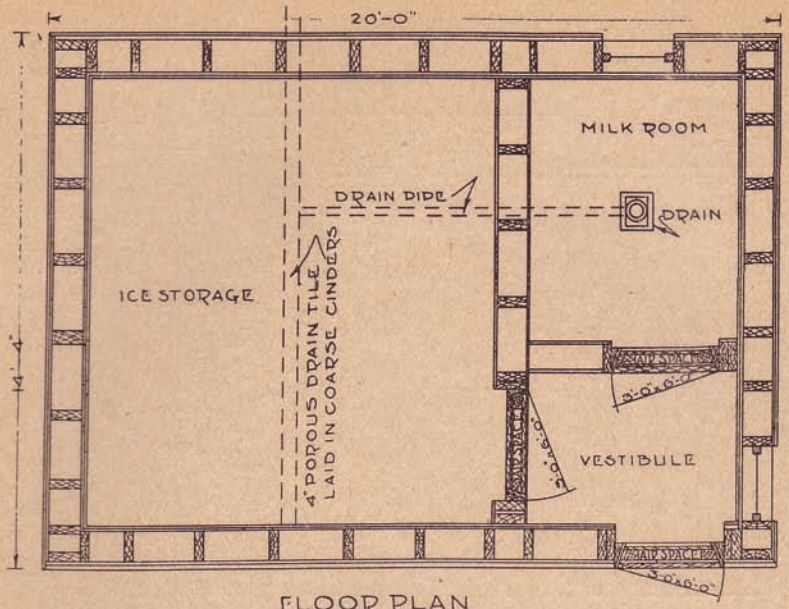


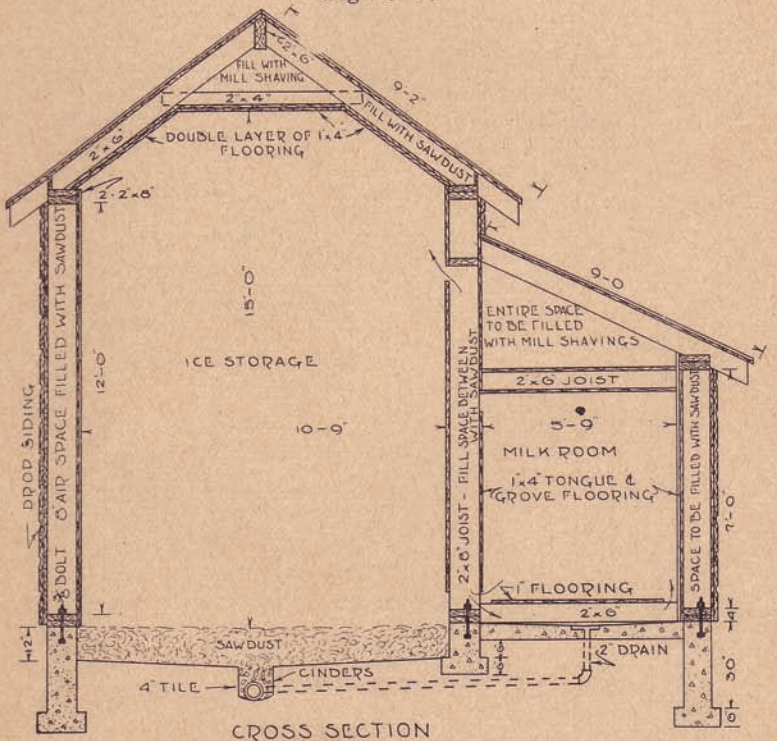
Figure 26

Plan No. 10.7921-1

Cross section of milk house shown in Figures 24 and 25.



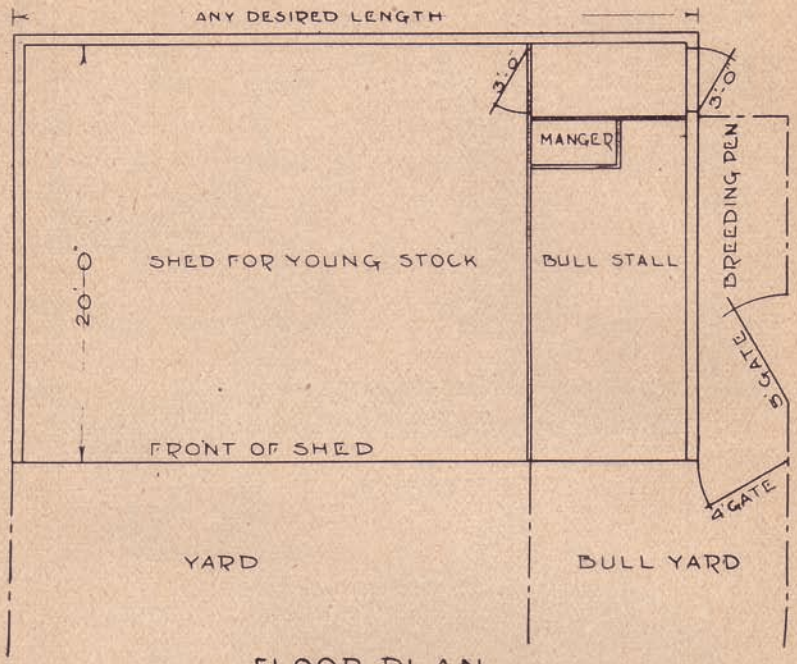
FLOOR PLAN
Figure 27



CROSS SECTION
Figure 28

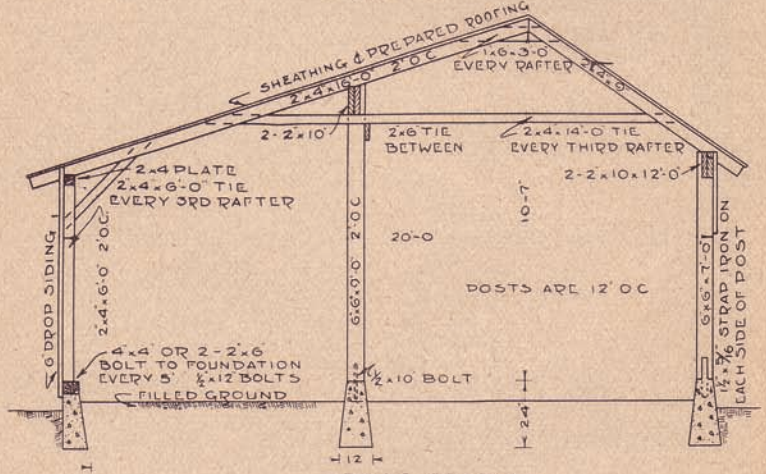
Plan No. 10.706-6

This plan is chiefly an ice house but has a milk room attached. The same roof covers both and the drain from the milk room empties into the drain from the ice house.



FLOOR PLAN

Figure 29

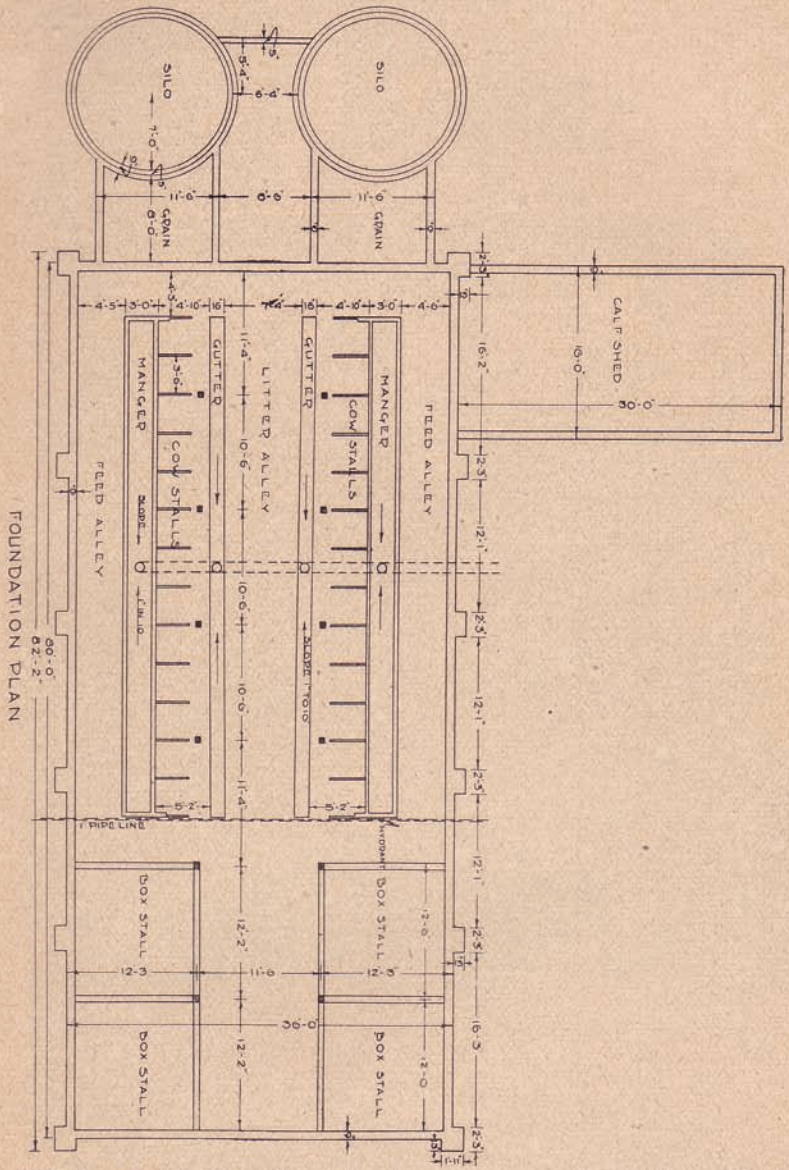


CROSS SECTION

Figure 30

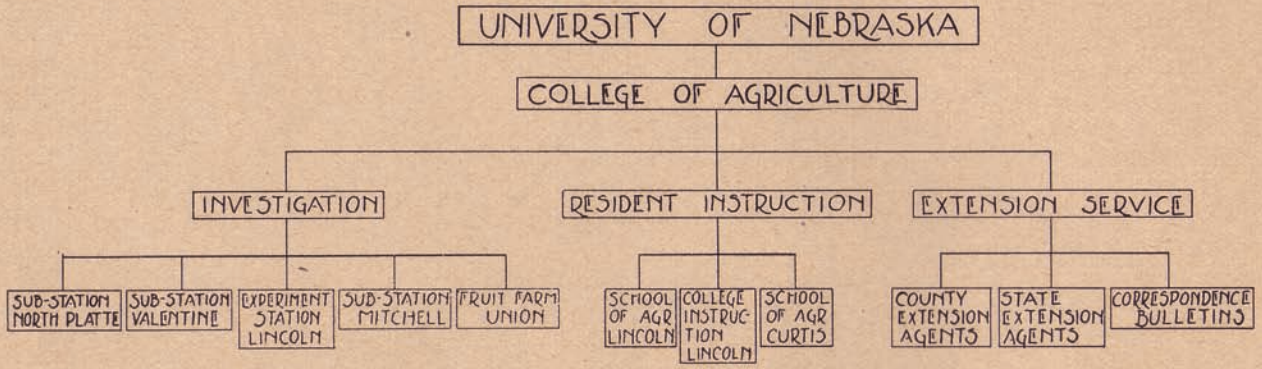
Plan No. 10.733-16

An open cattle shed for young stock. A partition cuts off one end which can be used as a bull stall. The manger, yard and breeding pen attached are so arranged that it is unnecessary for one to enter the stall or the pen.



This foundation plan shows the floor arrangement of a barn which has stall room for 26 cows. It will be noticed that these cows face out instead of in as shown in the other plans. 4 box stalls are also provided and a cattle shed is attached to one side of the barn. A grain bin is built in connection with each of the two silos.

THE COLLEGE OF AGRICULTURE AND ITS ACTIVITIES



This chart shows in graphic form the organization of the College of Agriculture. The College of Agriculture is one of ten colleges in the University of Nebraska, but has its own campus and buildings at Lincoln, besides experimental substations in various parts of the State. In addition to the customary instructional work of a college, it is responsible for experimental investigation and agricultural extension work. The instructional work includes instruction of college grade at Lincoln, instruction of high school grade thru the School of Agriculture at Lincoln, and instruction of high school grade thru the Nebraska School of Agriculture at Curtis. Experimental work and farming investigations are carried on at the main farms at Lincoln, and substations at North Platte, Valentine, and Mitchell, and at the fruit farm at Union. The Agricultural Extension Service represents the intimate contact between the college and the farmers of the State. This includes demonstrations by county and state extension agents, the distribution of bulletins, and practical service to the farmer, such as the answering of inquiries by mail.